

Military Crew Competence Model

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This paper presents a model for the analysis of military crew performance: Military Crew Competence Model (MCCM). The development of MCCM is based on a broad literature review including four lines of research and development. *Small Group Research* (e.g. Mc Grath, 1991; Bales and Cohen, 1979), which is historically the oldest line of research inquiry into social processes; *Management competencies* (e.g. Larson and Lafasto, 1989) a more recent line which focuses on improving the performance of individuals and on achieving measurable outcomes; *Crew Resource Management* (e.g. Driskell and Adams, 1992; Wiener et al., 1993) which is a key area of applied work focusing on improving safety through improved understanding of the human factors of military and civilian aircrews; *Models of Team Performance* (e.g. Swezey and Salas, 1992; Mitello et al., 1994; Fowlkes et al., 1994) which have shown a recent resurgence in activity in such areas as decision making and behavioural measures of performance. Key findings were then integrated into a generic mission-based model for diagnosing and measuring crew competencies.

Key function of the model is to provide a behaviourally based framework for assessing competencies influencing crew performance. The model is based on three components: *the externals*, *the internals* and *the outcomes*.

1 -- *The externals* represent the factors imposed on the crew; it comprises:

- * Mission conditions (*the contextuels*): timescales, physical resources, physical conditions, and constraints.

- * Crew characteristics (*the structurals*): number of crewmembers, technical skills, operational experience, familiarity with each other, and direct knowledge and experience of the mission to be undertaken.

2 -- *The internals*: relate to the crew's actions in undertaking tasks and seeking to achieve mission objectives. These actions are described in terms of the three critical crew competencies identified from the literature review (communicating, controlling, co-deciding).

3 -- *The outcomes*: success/failure in achieving mission objectives, are related to 3 general phases of a military mission (Preparation of mission - Execution of mission - Closing of mission).

The three competencies identified are defined as follows. *Co-deciding* refers to the active contribution of all crew members to defining a mission plan, allocating tasks, assigning roles, planning ahead for problems and emergencies. It also includes the decisions that crews have to face in emergency situations. *Communicating* includes both the content and style of communication, and the creation of a positive and supportive climate for

undertaking the crew's mission. *Controlling* refers to the crew's actions to track their performance as a crew against agreed targets, to detect problems and to coordinate crew activities. These three competencies all contribute to overall *Cohesion* of the crew which itself reinforces the other competencies.

MCCM proposes that levels of crew performance will be influenced by variations in externals (contextuals and structurals) and by the crew processes of co-deciding, communicating and controlling (the internals: crew actions). Since the focus of the actions will shift according to different phases of a mission, the nature of the evidence to be gathered (the outcomes) during different phases will also change. To this end, a broad model of mission phases is proposed as shown in Table 1.

Mission Phase	Outcomes
Pre-mission Preparation (Setting-up the Mission)	<p>Gather information on mission:</p> <ul style="list-style-type: none"> • Identify mission objectives • Review physical conditions for mission • Review resources for mission <p>Establish mission plan:</p> <ul style="list-style-type: none"> • Establish task • Establish priorities • Establish milestones & monitoring • Establish contingencies <p>Establish crew objectives:</p> <ul style="list-style-type: none"> • Establish crew roles & responsibilities • Establish common understanding of plan and crewmember's contributions • Establish workloads • Establish workload distribution & support

Mission Execution	<p>Evaluate mission progress:</p> <ul style="list-style-type: none"> • Monitor progress against plan & milestones • Monitor task performance • Monitor workloads • Establish whether resources & conditions are sufficient to continue with plan and/or mission <p>Manage unexpected events:</p> <ul style="list-style-type: none"> • Establish nature of event • Identify options & contingencies • Establish actions & priorities • Communicate intended actions • Evaluate responses
Mission Exit (Closing the Mission)	<p>Review mission performance:</p> <ul style="list-style-type: none"> • Encourage participation of crew • Focus contributions on improving crew/mission performance • Identify learning points for use in future mission

Table 1: General model of mission phases

The emphasis of the MCCM competencies will vary according to these broad mission phases. Accordingly, the Crew Competencies Questionnaire (CCQ) has been structured to reflect this. It comprises 45 statements organized into three sections related to MCCM structure: mission conditions, crew characteristics and crew actions. This third section is subdivided into three parts corresponding to the three phases of a mission (setting-up the mission, which relates to the planning of a mission; executing the mission, which includes dealing with problems and emergencies; closing the mission, which relates to the crew performance review). Three response choices are provided for each statement, ranging from positive or effective to negative or less effective behaviours. Scoring of the questionnaire is then a straightforward process of applying 0 to less effective response options, 1 to middle category options, and 2 to effective response options. This gives a score range of 0 to 2 for each statement, which can be standardised across sections on a 5 point scale. Scores can be obtained both by mission phase and by competency. Assessment of the external factors imposed on the crew (mission condition and crew characteristics) allows the analyst to put the assessment into the specific context of the mission. An example of the results that can be obtained through the CCQ is shown in Figure 1.



Figure 1: CCQ Feedback sheet for debriefing crew performance

It should be emphasized that the method itself will require evaluation in terms of validity and usability. Although it is an untried instrument, it has been designed with three areas of application in mind:

Training -- the CCQ could be used by instructors to record their observations of crew performance. It could help to diagnose crew skills early in training and to provide diagnostic feedback to trainee crews.

Crew Self-Diagnosis -- the CCQ could be completed by crewmembers after a training or mission. The average and spread of crew member's assessments could then be used to explore performance with crewmembers in a debrief session.

Accident Investigation -- CCQ could be used as the basis for a structured interview with those involved in an accident to identify whether problems in crew skills were a contributing factor. This follows Grubb et al.'s suggestion that the framework for measuring crew performance could be applied to improve methods of accident investigation (Grubb et al., 1993).

The instrument is available in French and in English. It is currently being evaluated as part of a European Co-operation for the Long Term in Defence (EUCLID) project (Research and Technology Project 11.1 on Training system concepts for simulator-based training) in terms of its usefulness as a measure of team performance for training.

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 [Back to Table of Contents](#)

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